

PAT-NO: JP410230376A  
DOCUMENT-IDENTIFIER: JP 10230376 A  
TITLE: METALLIC PLATE SHAPE JOINED BODY  
  
PUBN-DATE: September 2, 1998

**INVENTOR-INFORMATION:**

NAME	COUNTRY
MICHISAKA, KOUZOU	

**ASSIGNEE-INFORMATION:**

NAME	COUNTRY
SHOWA ALUM CORP	N/A

APPL-NO: JP09037301  
APPL-DATE: February 21, 1997

INT-CL (IPC): B23 K 020/12 , B23 K 020/24

**ABSTRACT:**

PROBLEM TO BE SOLVED: To obtain a metallic plate shape joined body by applying frictional agitation joining to joining members without limiting the joined strength of a joined body with the plate thickness and moreover without strictly controlling the shape or the like of the end part of joining members.

SOLUTION: In the plate shape joined body obtained by joining mutually end parts of two plate shape metallic joining members 1, 2, the bent part 10, wherein the end part is bent in the thickness direction in parallel, is provided in one end part of one side joining member 1, and the end part 20 of the other side joining member is superposed on the inside of the bent part 10 so that one side surfaces of both joining members 1, 2 are arranged on the same flat surface. Under this state, a rotating pin shape probe 32 is inserted in the superposed direction from the outside of the bent part 10, and frictional agitation joining is applied to the superposed part 4.

COPYRIGHT: (C)1998, JPO

JAPANESE

[JP,10-230376,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION  
TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS CORRECTION OR  
AMENDMENT

[Translation done.]

\* NOTICES \*

JPO and NCIP are not responsible for any  
damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

---

## DETAILED DESCRIPTION

---

### [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the metal plate manufacturing-like zygote used as the structure material and the other structure material for the cars of an automobile or an electric car.

[0002]

[Description of the Prior Art] The tabular zygote which joined two or more metal tabular joint material as tabular structure material used for the car of an automobile or an electric car may be used.

[0003] Conventionally, as shown in drawing 4, said tabular zygote compared the edge of tabular metal joint material (101) (102), and was manufactured by joining this comparison section by melting welding of argon gas arc welding etc.

[0004] However, when joining in the state of said comparison, since the bonding strength is influenced by the board thickness (T) of joint material (101) (102), in order to raise bonding strength, it needed processing to which only the edge concerning junction of joint material (101) (102) thickens board thickness (T), and enlarges a plane-of-composition product. Moreover, said melting welding needed to make the comparison section the suitable joint geometry, and its process for it increased, or the organization and presentation of a fusion part changed, and the mechanical strength of a zygote fell, or junction had a fault, such as difficulty or becoming impossible, depending on the kind of material of joint material.

[0005] Then, manufacturing said metal plate manufacturing-like zygote using the friction churning conjugation method which is one of the solid-state-welding methods joined without fusing joint material is proposed.

[0006] Said friction churning conjugation method is shown below. As shown in drawing 5, namely, on the end-face (131) axis of the cylindrical rotator (130) of path size Rotating said rotator (130) using the junction equipment (103) which the hard small-diameter pin-like probe (132) projected, and was formed in one rather than joint material (101) (102). Said probe (132) is inserted in the comparison section of the compared joint material (101) (102) of two sheets. Generally, insertion is performed until the end face (131) in which the probe (132) of a rotator (130) is formed contacts joint material. And along with the comparison section, a probe (132) is relatively moved to joint material (101) (102) with a probe insertion condition. With the frictional heat generated by rotation of a probe (132) and the rubbing of joint material (101) (102), or the frictional heat further generated in connection with the rubbing of the end face (131) of a rotator (130), and joint material (101) (102) While joint material (101) (102) softens [ near the contact part with a probe (132) ] and being agitated by the probe (132) After carrying out plastic flow with migration of a probe (132) in the mode around which it turns behind [ travelling direction ] a probe (132) so that a softening churning part may fill the passage slot on the probe (132) in response to the advance pressure of a probe (132), frictional heat is lost quickly and cooling solidification is carried out. This phenomenon is successively repeated with migration of a probe (132), and finally joint material compares and it is joined in the section.

[0007]

[Problem(s) to be Solved by the Invention] If a tabular zygote is manufactured using said friction churning conjugation method, it is not necessary to process the joint geometry for melting welding on a joint material edge and, and a limit cannot be received in the class of metal material which is joint material, or that there is little deformation of the presentation and organization by the heat at the time of junction etc. can cancel a fault peculiar to melting welding. However, even if it used the friction churning conjugation method, in order to be dependent on the board thickness (T) of an abutting-surface product, i.e., joint material, like melting welding, as it is shown in drawing 5, in order for bonding strength to raise bonding strength, the need of comparing and processing the board thickness of the section thickly still remained. Furthermore, since a junction activity would be checked if it becomes the cause of poor junction and curvature and a knee are in joint material if a clearance and the dislocation between both plates are in the comparison section when performing friction churning junction in the state of comparison, the end shape of joint

material needed to be managed strictly.

[0008] This invention is made in view of the above-mentioned technical problem, and it aims at offer of the metal plate manufacturing-like zygote obtained by carrying out friction churning junction of the joint material, without the bonding strength of a zygote not being restricted by board thickness, and managing the configuration of a joint material edge etc. strictly.

[0009]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the metal plate manufacturing-like zygote concerning this invention It is the tabular zygote which joins the edges of the tabular metal joint material of two sheets, and is obtained. After the edge of the joint material of another side has piled up in the inside of said flection, so that the flection to which the edge concerned was crooked in the shape of parallel in the thickness direction may be prepared in the edge of one joint material and one field of both joint material may be arranged on the same flat surface It is characterized by inserting the pin-like probe which rotates from the outside of a flection in the direction of superposition, and coming to carry out friction churning junction of the superposition section.

[0010] Since it comes to manufacture the metal plate manufacturing-like zygote of said configuration by the friction churning conjugation method which is a solid-state-welding method, change of an organization or a presentation is seen neither in a joint nor its near, but it is made with the high zygote of a mechanical strength as a whole. Moreover, in the production process, since friction churning junction of the probe is inserted and carried out from the field opposite to the field which is in the condition which piled up the flection and edge of joint material, and has been arranged on the same flat surface, the fields of both joint material are joined in the condition of having always contacted. Therefore, even if it does not manage the configuration of a joint material edge etc. strictly, a zygote without poor junction is manufactured. Furthermore, by setting up the superposition area of a joint material edge, since bonding strength can be set as arbitration, it can consider as the metal plate manufacturing-like zygote which has predetermined bonding strength, without being influenced by the board thickness of joint material.

[0011]

[Embodiment of the Invention] Next, the gestalt of operation concerning this invention is explained, referring to the sign in drawing.

[0012] Drawing 1 is drawing having shown the condition that the edge of the cross direction of joint material (1) and (2) piled up, and the superposition section (4) concerned was joined by junction equipment (3).

[0013] Said joint material (1) and (2) are the tabular members of the product made from aluminum of the same thickness, and the flection (10) to which the edge concerned was crooked in the shape of parallel in the thickness direction is prepared in the edge of the cross direction of one joint material (1) covering the whole die-length direction. Moreover, extent of crookedness of said flection (10) is in the condition which the edge (20) of the joint material (2) of another side put on the inside, and it is set up so that the front face (11) of both joint material (1) and (2) and (21) may become the same flat surface.

[0014] A hard small-diameter pin-like probe (32) projecting said junction equipment (3) from joint material (1) and (2), it being formed on the edge axis of the cylindrical rotator (30) of path size, at one, and rotating said probe (32) By making it insert and move to the superposition section (4) of the joint material (1) of two sheets, and (2), joint material (1) and (2) are joined in the state of superposition.

[0015] And as shown in drawing 2, after the edge (20) has piled up the metal plate manufacturing-like zygote inside the flection (10) of joint material (1), by said junction equipment (3), it comes to carry out friction churning junction in the direction of superposition, and the whole surface of a zygote is made with flatness.

[0016] Next, the manufacture approach of the zygote concerning this operation gestalt is explained.

[0017] After making the edge of joint material (1) crooked in a predetermined configuration and forming a flection (10), superposition, joint material (1), the front face (11) of (2), and (21) are arranged for the edge (20) of joint material (2) on the same flat surface inside said flection (10).

[0018] Next, a probe (32) is inserted in the superposition section (4) from the rear-face [ of the superposition section (4) ] (12), and (22) side, rotating the rotator (30) of said junction equipment (3). Insertion is performed until the end face (31) in which the probe (32) of a rotator (30) was formed forces a flection (10) front face. The probe (32) penetrated one joint material (1) in this condition, and it has reached near the front face (21) of the joint material (2) of another side. And along with the superposition section (4), a rotator (30) and a probe (32) are moved relatively [ direction / of joint material (1) and (2) / die-length ] with said condition, and it joins, pressing the superposition section (4) in the direction of superposition, and sticking the field of joint material (1) and (2) by the end face (31) of a rotator (30). With the frictional heat generated by rotation of a probe (32) and the rubbing of joint material (1) and (2), or the frictional heat further generated in connection with the end face (31) of a rotator (30), and rubbing with one joint material (1) Probe While joint material (1) and (2) soften [ near the contact part of (32) ] and being agitated by the probe (32) After carrying out plastic flow with migration of a probe (32) in the mode around which it turns behind

[ travelling direction ] a probe (32) so that a softening churning part may fill the passage slot on the probe (32) in response to the advance pressure of a probe (32), frictional heat is lost quickly and cooling solidification is carried out. This phenomenon is successively repeated with migration of a probe (32), finally friction stirring junction of the superposition section (4) of joint material (1) and (2) is carried out covering the whole die-length direction, and a metal plate manufacturing-like zygote is obtained.

[0019] In the production process of the metal plate manufacturing-like zygote concerning this operation gestalt Since it is joined the superposition section (4) of joint material (1) and (2) being forced in the direction of superposition by the end face (31) of a rotator (30), It is joined by said pressure, being right set, even if curvature and a knee are in the edge of joint material (1) and (2), and the field of joint material (1) and (2) is always joined in the state of adhesion. Therefore, although the obtained metal plate manufacturing-like zygote does not need to manage strictly the condition of the edge of joint material (1) and (2), it is made with a good zygote without poor junction. Furthermore, since the front face (11) of the junction side of joint material (1) and (2) and the opposite side and (21) are arranged on the same flat surface, a root crack etc. does not generate them. Therefore, the obtained zygote has the flat whole surface and is made with the high zygote of design nature.

[0020] Moreover, since a metal plate manufacturing-like zygote joins joint material (1) and (2) with a friction churning conjugation method and it is obtained, a joint is not fused only by carrying out plastic flow, but there is no change of an organization or a presentation in a joint or its near, and it can have a mechanical strength high as the whole zygote.

[0021] Furthermore, the touch area of the superposition section (4) of joint material (1) and (2) is set up suitably, the configuration of a probe (32) can be changed or bonding strength can be set as arbitration by making migration of a probe (32) move in a zigzag direction, and it can consider as the metal plate manufacturing-like zygote which has predetermined bonding strength, without being influenced by the board thickness of joint material (1) and (2).

[0022] In addition, as it is the purpose filled up with the clearance section (40) which exists in the front-face [ which is shown in drawing 2 / of the superposition section (4) ] (11), and (21) side, or it serves also as the purpose which strengthens junction and it is shown in drawing 3, it is good for said clearance section (40) or its near also as the friction churning junction from a front-face (11) side and the (21) sides, or a thing which performs welding etc. in addition to this.

[0023] In addition, this invention is not necessarily limited to the above-mentioned operation gestalt. For example, the quality of the material of a zygote may necessarily be limited to neither aluminum nor its alloy, and all metals, such as a steel plate and a copper plate, and an alloy are sufficient as it. Moreover, you may be the metal plate manufacturing-like zygote obtained by carrying out friction churning junction of the joint material from which board thickness and a kind of material differ.

[0024]

[Effect of the Invention] By above-mentioned order, in said flection and edge of the joint material of another side, friction churning junction is carried out and the metal plate manufacturing-like zygote concerning this invention is obtained [ section / concerned / superposition and / superposition ] so that one field of both joint material may be arranged on the same flat surface, while preparing a flection in one joint material. Therefore, it is made with the high zygote of a mechanical strength with which change of an organization or a presentation is seen neither in a joint nor its near. Moreover, since it will be the flection and edge of joint material in a superposition condition, and a pin is inserted from the outside of a flection and friction churning junction of the superposition section is carried out, even if it is joined in the condition of having always stuck and the fields of both joint material do not manage the configuration of a joint material edge etc. strictly, it can consider as a zygote without poor junction. Furthermore, since \*\*\*\*\* as a result bonding strength can be set as arbitration by setting up the superposition area of a joint material edge, it can make with the metal plate manufacturing-like zygote which has predetermined bonding strength, without being influenced by the board thickness of joint material.

---

[Translation done.]

(19)日本国特許庁 (JP)

(12) 公開特許公報 (A)

(11)特許出願公開番号

特開平10-230376

(43)公開日 平成10年(1998)9月2日

(51)Int.Cl.<sup>o</sup>

B 23 K 20/12  
20/24

識別記号

F I

B 23 K 20/12  
20/24

G

審査請求 未請求 請求項の数1 OL (全5頁)

(21)出願番号 特願平9-37301

(22)出願日 平成9年(1997)2月21日

(71)出願人 000186843

昭和アルミニウム株式会社  
大阪府堺市海山町6丁224番地

(72)発明者 道阪 浩三

堺市海山町6丁224番地 昭和アルミニウム株式会社内

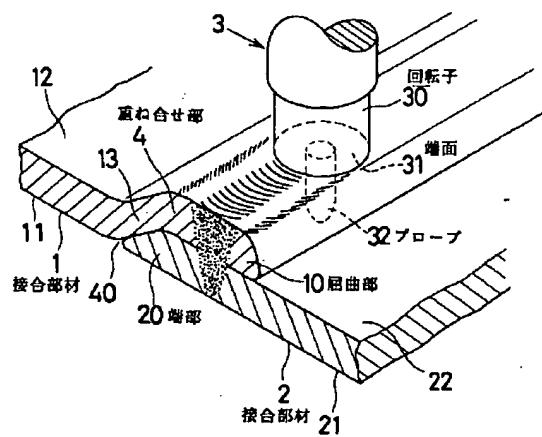
(74)代理人 弁理士 清水 久義 (外2名)

(54)【発明の名称】 金属製板状接合体

(57)【要約】

【課題】 接合体の接合強度が板厚によって制限されることがなく、かつ、接合部材端部の形状等を厳密に管理することなく、接合部材を摩擦搅拌接合して得られる金属製板状接合体の提供。

【解決手段】 2枚の板状の金属製接合部材1、2の端部どうしを接合して得られる板状の接合体であって、一方の接合部材1端部に、当該端部が厚さ方向に平行状に屈曲された屈曲部10を設け、両接合部材1、2の一方の面が同一平面上に配置されるように、前記屈曲部10の内側に他方の接合部材の端部20を重ね合せた状態とし、屈曲部10の外側から回転するピン状のプローブ32を重ね合せ方向に挿入して、当該重ね合せ部4を摩擦搅拌接合し金属製板状接合体を得る。



## 【特許請求の範囲】

【請求項1】 2枚の板状の金属製接合部材の端部どうしを接合して得られる板状の接合体であって、一方の接合部材の端部に、当該端部が厚さ方向に平行状に屈曲された屈曲部が設けられ、両接合部材の一方の面が同一平面上に配置されるように、前記屈曲部の内側において他方の接合部材の端部が重ね合された状態で、屈曲部の外側から回転するピン状のプローブを重ね合せ方向に挿入して、重ね合せ部が摩擦攪拌接合されてなることを特徴とする金属製板状接合体。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】この発明は、自動車や電車の車両用の構造材、その他構造材として用いられる金属製板状接合体に関する。

## 【0002】

【従来の技術】自動車や電車の車両に用いられる板状の構造材として、複数の金属製の板状接合部材を接合した板状の接合体が用いられることがある。

【0003】従来、前記板状の接合体は、図4に示すように、板状の金属製接合部材(101)(102)の端部を突き合わせ、この突き合わせ部をアルゴン溶接等の溶融溶接によって接合することにより製造されていた。

【0004】しかし、前記突き合わせ状態で接合する場合は、その接合強度は接合部材(101)(102)の板厚(T)に影響されるため、接合強度を向上させるためには、接合部材(101)(102)の接合にかかる端部のみ板厚(T)を厚くして接合面積を大きくする加工が必要であった。また、前記溶融溶接は、突き合わせ部を適当な開先形状にする必要があり、このための工程が増えるとか、溶融部分の組織や組成が変化して接合体の機械的強度が低下するとか、接合部材の材種によっては接合が困難または不可能となる等の欠点を有していた。

【0005】そこで、接合部材を溶融せずに接合する固相接合法の一つである摩擦攪拌接合法を用いて前記金属製板状接合体を製造することが提案されている。

【0006】前記摩擦攪拌接合法とは以下に示すものである。即ち、図5に示すように、径大の円柱状回転子(130)の端面(131)軸線上に、接合部材(101)(102)よりも硬質の径小のピン状プローブ(132)が突出して一体に設けられた接合装置(103)を用い、前記回転子(130)を回転させつつ、突き合わせた2枚の接合部材(101)(102)の突き合わせ部に前記プローブ(132)を挿入する。挿入は、一般には、回転子(130)のプローブ(132)が設けられている端面(131)が接合部材に当接するまで行う。そして、プローブ挿入状態のまま突き合わせ部に沿ってプローブ(132)を接合部材(101)(102)

2)に対して相対的に移動させる。プローブ(132)の回転と接合部材(101)(102)の摺擦により発生する摩擦熱、あるいはさらに回転子(130)の端面(131)と接合部材(101)(102)との摺擦に伴い発生する摩擦熱により、プローブ(132)との接触部分近傍において接合部材(101)(102)が軟化しつつプローブ(132)により攪拌されるとともに、プローブ(132)の移動に伴って、軟化攪拌部分がプローブ(132)の進行圧力を受けてプローブ(132)の通過溝を埋めるようにプローブ(132)の進行方向後方へと回り込む様で塑性流動したのち摩擦熱を急速に失って冷却固化される。この現象がプローブ(132)の移動に伴って順次繰り返されていき、最終的に接合部材が突き合わせ部において接合されるものである。

## 【0007】

【発明が解決しようとする課題】前記摩擦攪拌接合法を用いて板状の接合体を製造すれば、接合部材端部に溶融溶接用の開先形状を加工する必要がなく、また、接合部材である金属材の種類に制限を受けないとか、接合時の熱による組成や組織の変形が少ない等、溶融溶接特有の欠点を解消することができる。ところが、摩擦攪拌接合法を用いても、接合強度は溶融溶接と同様突き合わせ面積、即ち、接合部材の板厚(T)に依存するため、図5に示すように、接合強度を向上させるためには突き合わせ部の板厚を厚く加工する必要が依然として残っていた。さらに、突き合わせ状態で摩擦攪拌接合を行う場合は、突き合わせ部に隙間や目違いがあれば接合不良の原因となり、接合部材に反りや曲りがあると接合作業が阻害されるため、接合部材の端部形状を厳密に管理する必要があった。

【0008】この発明は、上記課題に鑑みてなされたものであり、接合体の接合強度が板厚によって制限されることなく、かつ、接合部材端部の形状等を厳密に管理することなく、接合部材を摩擦攪拌接合して得られる金属製板状接合体の提供を目的とする。

## 【0009】

【課題を解決するための手段】上記の目的を達成するために、この発明にかかる金属製板状接合体は、2枚の板状の金属製接合部材の端部どうしを接合して得られる板状の接合体であって、一方の接合部材の端部に、当該端部が厚さ方向に平行状に屈曲された屈曲部が設けられ、両接合部材の一方の面が同一平面上に配置されるように、前記屈曲部の内側において他方の接合部材の端部が重ね合された状態で、屈曲部の外側から回転するピン状のプローブを重ね合せ方向に挿入して、重ね合せ部が摩擦攪拌接合されてなることを特徴とするものである。

【0010】前記構成の金属製板状接合体は、固相接合法である摩擦攪拌接合法によって製造されてなるもので50あるから、接合部やその近傍に組織や組成の変化が見ら

れず、全体として機械的強度の高い接合体となされる。また、その製造工程においては、接合部材の屈曲部と端部を重ね合せた状態で、かつ、同一平面上に配置された面と反対の面からプローブが挿入されて摩擦搅拌接合されているため、両接合部材の面どうしが常に接触した状態で接合される。したがって、接合部材端部の形状等を厳密に管理しなくても接合不良のない接合体が製造される。さらに、接合部材端部の重ね合せ面積を設定することで、接合強度を任意に設定することができるため、接合部材の板厚に影響されることなく所定の接合強度を有する金属製板状接合体とすることができる。

## 【0011】

【発明の実施の形態】次に、この発明にかかる実施の形態を図中の符号を参照しつつ説明する。

【0012】図1は、接合部材(1)(2)の幅方向の端部が重ね合され、接合装置(3)により当該重ね合せ部(4)が接合されている状態を示した図である。

【0013】前記接合部材(1)(2)は同一厚さのアルミニウム製の板状の部材であり、一方の接合部材(1)の幅方向の端部には、当該端部が厚さ方向に平行状に屈曲された屈曲部(10)が長さ方向全体にわたって設けられている。また、前記屈曲部(10)の屈曲の程度は、その内側に他方の接合部材(2)の端部(20)が重ね合された状態で、両接合部材(1)(2)の表面(11)(21)が同一平面となるように設定されている。

【0014】前記接合装置(3)は、径大の円柱状回転子(30)の端部軸線上に、接合部材(1)(2)よりも硬質の径小のピン状プローブ(32)が突出して一体に設けられたものであり、前記プローブ(32)を回転させつつ、2枚の接合部材(1)(2)の重ね合せ部(4)に挿入し移動させることで、接合部材(1)(2)を重ね合せ状態で接合するものである。

【0015】そして、図2に示すように、金属製板状接合体は、接合部材(1)の屈曲部(10)の内側に端部(20)が重ね合わされた状態で、前記接合装置(3)によって重ね合せ方向に摩擦搅拌接合されてなるものであり、接合体の一面は平坦となされている。

【0016】次に、この実施形態にかかる接合体の製造方法を説明する。

【0017】接合部材(1)の端部を所定の形状に屈曲させて屈曲部(10)を形成した後、前記屈曲部(10)の内側に接合部材(2)の端部(20)を重ね合せ、接合部材(1)と(2)の表面(11)(21)を同一平面上に配置する。

【0018】次に、前記接合装置(3)の回転子(30)を回転させつつ、重ね合せ部(4)の裏面(12)(22)側から重ね合せ部(4)にプローブ(32)を挿入する。挿入は、回転子(30)のプローブ(32)が設けられた端面(31)が屈曲部(10)表面を押し

付けるまで行う。この状態でプローブ(32)は一方の接合部材(1)を貫通し、他方の接合部材(2)の表面(21)近傍に達している。そして、前記状態のまま重ね合せ部(4)に沿って回転子(30)及びプローブ(32)を接合部材(1)(2)の長さ方向に相対的に移動させ、回転子(30)の端面(31)によって重ね合せ部(4)を重ね合せ方向に押圧し接合部材(1)

(2)の面を密着させつつ接合する。プローブ(32)の回転と接合部材(1)(2)の摺擦により発生する摩擦熱、あるいはさらに回転子(30)の端面(31)と一方の接合部材(1)との摺擦に伴い発生する摩擦熱により、プローブ(32)との接触部分近傍において接合部材(1)(2)が軟化しつつプローブ(32)により搅拌されるとともに、プローブ(32)の移動に伴って、軟化搅拌部分がプローブ(32)の進行圧力を受けてプローブ(32)の通過溝を埋めるようにプローブ(32)の進行方向後方へと回り込む様で塑性流動したち摩擦熱を急速に失って冷却固化される。この現象がプローブ(32)の移動に伴って順次繰り返されていき、最終的に接合部材(1)(2)の重ね合せ部(4)が長さ方向全体にわたって摩擦搅拌接合され、金属製板状接合体が得られる。

【0019】この実施形態にかかる金属製板状接合体の製造工程においては、接合部材(1)(2)の重ね合せ部(4)が回転子(30)の端面(31)によって重ね合せ方向に押し付けられつつ接合されるため、前記押し付け力によって接合部材(1)(2)の端部に反りや曲りがあつても矯正されつつ接合され、接合部材(1)(2)の面が常に密着状態で接合される。したがって、得られた金属製板状接合体は、接合部材(1)(2)の端部の状態を厳密に管理する必要がないにもかかわらず、接合不良のない良好な接合体となれる。さらに、接合部材(1)(2)の接合側と反対側の表面(11)(21)は同一平面上に配置されているためルート割れ等が発生することもない。したがって、得られた接合体は、一面が平坦で意匠性の高い接合体となれる。

【0020】また、金属製板状接合体は、摩擦搅拌接合法により接合部材(1)(2)を接合して得られたものであるから、接合部は塑性流動するのみで溶融しておらず、接合部やその近傍に組織や組成の変化がなく、接合体全体として高い機械的強度を有することができる。

【0021】さらに、接合部材(1)(2)の重ね合せ部(4)の接触面積を適宜設定し、プローブ(32)の形状を変えたりプローブ(32)の移動を蛇行させることで、接合強度を任意に設定することができ、接合部材(1)(2)の板厚に影響されることなく所定の接合強度を有する金属製板状接合体とすることができます。

【0022】なお、図2に示す重ね合せ部(4)の表面(11)(21)側に存在する隙間部(40)を充填する目的で、または、接合を強化する目的も兼ねて、図3

に示すように、前記隙間部(40)またはその近傍に表面(11)(21)側から摩擦搅拌接合やその他溶接等を施すものとしても良い。

【0023】なお、この発明は上記実施形態に限定されるわけではない。例えば、接合体の材質はアルミニウムやその合金に限定されるわけではなく、鋼板や銅板等あらゆる金属や合金でも良い。また板厚や材種が異なる接合部材を摩擦搅拌接合して得られた金属製板状接合体であっても構わない。

#### 【0024】

【発明の効果】この発明にかかる金属製板状接合体は、上述の次第で、一方の接合部材に屈曲部を設けるとともに、両接合部材の一方の面が同一平面上に配置されるよう前記屈曲部と他方の接合部材の端部を重ね合せ、当該重ね合せ部を摩擦搅拌接合して得られたものである。したがって、接合部やその近傍に組織や組成の変化が見られない機械的強度の高い接合体となされている。また、接合部材の屈曲部と端部が重ね合せ状態となされ、かつ、屈曲部の外側からピンを挿入されて重ね合わせ部が摩擦搅拌接合されているため、両接合部材の面どうしが常に密着した状態で接合され、接合部材端部の形状等を厳密に管理しなくとも接合不良のない接合体とすることはできる。さらに、接合部材端部の重ね合せ面積を設

定することで、接合面積ひいては接合強度を任意に設定することができるため、接合部材の板厚に影響されることなく所定の接合強度を有する金属製板状接合体となしうる。

#### 【図面の簡単な説明】

【図1】この発明にかかる実施形態の接合状況を示す断面斜視図である。

【図2】図1の接合後の状態を示す断面図である。

【図3】図2の隙間を埋めた状態を示す断面図である。

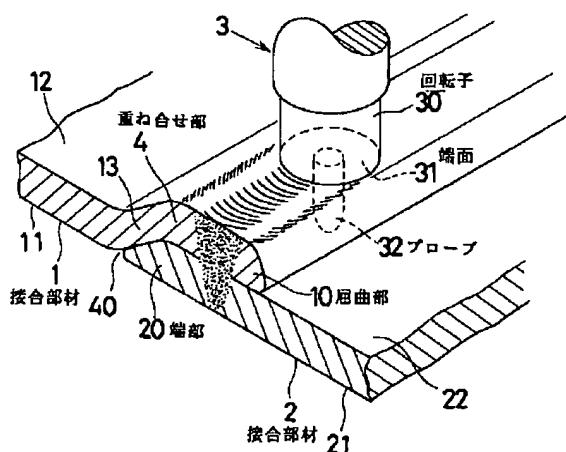
【図4】従来の溶融溶接における突き合せ部の形状を示した断面図である。

【図5】突き合せ状態での摩擦搅拌接合法を示す斜視図である。

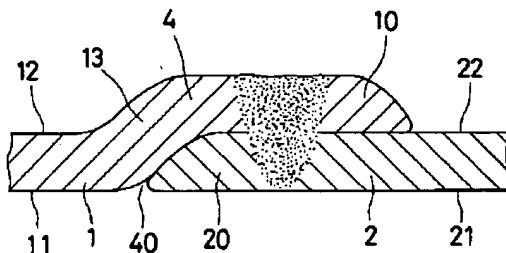
#### 【符号の説明】

- 1…接合部材
- 2…接合部材
- 4…重ね合せ部
- 10…屈曲部
- 20…端部
- 30…回転子
- 31…端面
- 32…プローブ

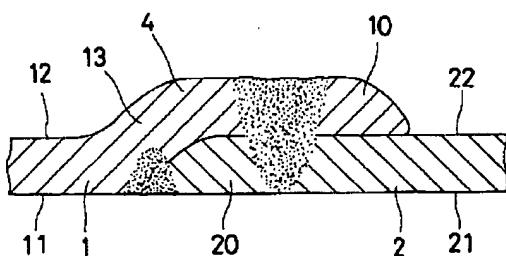
【図1】



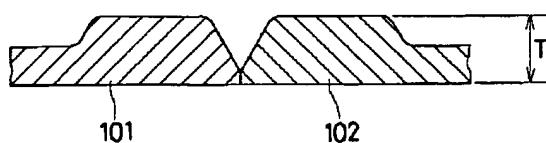
【図2】



【図3】



【図4】



【図5】

